

13 January 2004

Mr. Richard Looker  
Water Resources Control Engineer  
TMDL Section  
San Francisco Regional Water Quality Control Board  
1515 Clay Street, Suite 1400  
Oakland, CA 94612

Dear Mr. Looker,

Please find below the comments on the proposed Basin Plan amendment related to the TMDL for mercury in San Francisco Bay. Note that comments are organized into general and specific comment sections. When possible, page numbers, paragraphs, figures, and tables are referred to by number. The document reviewed was:

- ❑ CRWQCB-SFB. 2003. Mercury in San Francisco Bay: Total Maximum Daily Load (TMDL) for Proposed Basin Plan Amendment and Staff Report. Prepared by Richard Looker and Bill Johnson. October 24, 2003 Scientific Review Draft.

### **General Comments.**

Overall, the proposed TMDL amendment addresses the required components of a TMDL according to U.S. EPA guidelines. Application of one TMDL for the entire San Francisco Bay is questioned. This is in part because of the differences between the southern reaches of the Bay relative to the northern and Delta regions with respect to depth, flushing, tidal influences, riverine inputs, and data availability. In addition, the inclusion of Castro Cove, Oakland Inner Harbor and San Leandro Bay is questioned.

There are considerable concerns about the simplifications made by using the one-box model and its accompanying assumptions. While the value of the one-box model is well documented, it is generally applied to a less complex system. There are inadequacies with the report, addressed below, that make it incomplete. The source analysis conclusions appear justified; the major sources of seem well defined. The linking analysis is based on limited information, and is more anecdotal than technical. The proposed numeric targets are based on limited data, and focus much on average or median values for the entire San Francisco Bay. Waste load allocations are well documented, but not always justified. Critical conditions and seasonal variability are assumed insignificant, with no technical basis. The margin of safety section is limited, and in some cases, not present. The model does not use the most

conservative assumptions available. There is no discussion of the 10% explicit margin of safety, but rather, a weak claim that an implicit margin of safety is sufficient. The implementation plan is routine, vague with respect to monitoring approaches, and not supported by data. Detailed cost information is provided, however the range of per unit costs is quite significant.

Per the guidance provided for technical reviewers, brief comments are made below. Details are provided in the specific comments section that follows.

### **Problem Statement - Key Technical Issues**

There are not any key issues for review pertaining to the problem statement.

### **Numeric Targets - Key Technical Issues**

Are the target derivations sensible and based on sound scientific principles? Yes, in general although there are some concerns about the limited data and application of the data to such a large area. Do we make justifiable claims regarding the protectiveness of the targets? Not always.

### **Source Assessment - Key Technical Issues**

Are the source estimates and estimation methodologies clearly stated? Yes  
Are the estimation methodologies scientifically sound? Yes, with some concerns described below.  
Are the estimation uncertainties clearly stated, and are the uncertainties reasonable in light of system variability and measurement techniques? Uncertainties need to be more clearly stated.  
Is the discussion of suggested work to reduce areas of uncertainty clearly stated and scientifically sound? Yes

### **Linkage Analysis - Key Technical Issues**

Are the linkages between sources and the numeric targets and water quality objectives clearly stated and scientifically sound? The linkage analysis is somewhat limited in scope and is not as technical as it could be.

### **Load Allocations - Key Technical Issues**

Is the methodology for arriving at load allocations clearly stated and scientifically sound? Yes.

### **Margin of Safety - Key Technical Issues**

Is the method of ensuring a margin of safety clearly stated and technically sound? This is a weak point of the document and needs further work.

### **Implementation Actions - Key Technical Issues**

Are the implementation actions clearly stated? Not always. Often somewhat vague statements are made.  
Despite the remaining uncertainties, have we reasonably demonstrated that the implementation actions to reduce loading and methylation of mercury will accomplish their intended goals? The implementation actions, as described, are a step towards mercury reduction in SF Bay.  
Have we clearly stated the goals of the monitoring program? No.

Have we reasonably demonstrated that the monitoring program is sufficient to address the areas of remaining technical uncertainty? No

Have we reasonably demonstrated that the monitoring program is sufficient to track mercury concentration trends in fish, birds, sediment, and water. No

Are data used in the report reliable and appropriate, and is the treatment of the data defensible?

Generally, the data presented are reliable and appropriate. Some applications of data are questioned. In addition, some parts of the document need a more technical approach.

Does the report as a whole support its scientific conclusions and recommendations? Yes, with some gaps, questionable assumptions.

Given this brief summary, the comments below can be used to improve, support or refute additional comments as appropriate. The comments are meant in all cases to be constructive, to help make the document more clear, easier to read, and understandable.

### **Specific Comments.**

<u>Page</u>	<u>Comment</u>
9	Figure 2.2: Extreme values for the Guadalupe River that are off scale are supportive of the conclusion that the South Bay should be treated separately, and that a basin-wide TMDL for SFB is inappropriate. A summary of the data is recommended. This should include the number of samples collected, numerical range, and time period of collection at a minimum for each sub-area considered.
12	Paragraph 5: The active sediment zone described is clear, however later in the report (pages 17-18) the value used in calculations changes. This brings to question the validity of the one-box model applied.
14	Figure 3.2: Losses associated with biomass removal via fishing, uptake by biota (waterfowl, fish), or adsorption onto surfaces is not addressed.
16	Table 4.1: It should be made clear in the table notes that bed erosion is estimated for San Pablo Bay and Suisun Bay only, with the assumption that bed erosion from all other segments of the SF Bay assumed to be negligible. In addition, the mercury load for the Central Valley Watershed should be 416 kg/yr, not 440 kg/yr.
17	Paragraph 2-3: It is unclear why bed erosion is based on the average mercury concentration in the top 1.3 meters of sediment. According to page 12, the active sediment layer

is approximately 15 cm (6 inches). In additions, per Figure 4.2, the mercury concentration decreases significantly below 0.9 meters, resulting in a lower depth weighted average than would be determined using a more shallow depth. Also, use of data from Grizzly Bay and San Pablo Bay to represent bed erosion from the entire SF bay is not justified. The assumption that mercury loads from bed erosion from other bay segments are negligible is not sufficient.

- 18 Paragraph 1. The collection of sediment cores at depths of 0.7 meters and greater may result in loss of mercury data of importance. As shown in Figure 4.2, maximum mercury concentrations were measured between 0.4 and 0.7 meters in Grizzly Bay, to which parts of the South Bay are compared. Omission of the Triangle Marsh data is questioned. Time data should be addressed: when were the sediments deposited; when did the marsh develop. Changes in marsh development, water availability (required flows to Guadalupe from IBM) and other factors are important to consider prior to such an omission.
- 19 Paragraph 1: The net annual sediment loss of 1,100 M kg/yr should be stated as for San Pablo Bay and Suisun Bay only. As stated, the loss, and load of mercury are not valid for all Bay segments.
- 19 Paragraph 3: The Central Valley mercury load is 416 kg/yr.
- 19 Paragraph 4: The Central Valley mercury load estimate could be overstated or understated.
- 20 Paragraph 3: The lack of data for agricultural drainages is a major omission. Agricultural uses of mercury are well documented (<http://www.epa.gov/glnpo/bnsdocs/hgsbook/agr.pdf>) and are of great concern. According to the USGS (<http://oh.water.usgs.gov/nawqa/lerinews.pdf>), agricultural uses are responsible for considerable contaminant loading to surface waters. Treatment of agricultural land as open space with little to no data is not acceptable, particularly given the percent of the basin for which agriculture is the primary land use. This assumption could greatly underestimate the load associated with this land use. Agricultural use of municipal sludge, which is known to be elevated in terms of mercury concentration, should also be addressed.

- 21      Bullet 2: Total sediment load estimates for urban and non-urban areas are compromised by the inclusion of agriculture in the non-urban category. Sediment loss due to agricultural practices is well documented by the NRCS. “**Sediment loss** from agricultural land continues to be ranked as the leading source of water pollution.” according to [www.ohleap.org/FactSheets/economic.rtf](http://www.ohleap.org/FactSheets/economic.rtf).
- 23      Paragraph 3: The method used to estimate the storm water load underestimates the load by a factor of 2 to 3 according to page 21 of the report. This point should be made.
- The statement is made that the assumption that all sediment discharged from the Guadalupe River would be discharged with or without the mining legacy may be an overstatement is unclear and without explanation.
- 24      Paragraph 1: Concentrations of mercury in fog should be assessed. Ritts and Williamson (1992) found that PCB concentrations were the highest when measured in fog in the San Francisco Bay region. A similar result may apply to mercury.
- 25      Paragraph 3: The assessment of mercury attributed to industrial discharges is basically non-existent (2 sentences). Discharges from the Central Valley are not addressed at all. The references cited apply to wastewater. More details need to be provided.
- 27      Paragraph 2: Data for sediment dredging and disposal are confusing in that in-bay disposal volumes are for 1991-1999, and out of bay disposal volumes are for 1999-2001. As stated, volumes dredged vary from year to year. In addition, if the effects of the LTMS resulted in an increase in out of bay volume disposals in later years, then the total material dredged value will be underestimated for 1991-1999. Data should be presented on a year by year basis for these criteria.
- 28      Table 4.5: Inclusive dates for the data should be indicated on the table.
- 28      Paragraph 1 and (\*) in Table 4.5. It is recommended that the units used be consistent. The assumptions made for the kilograms of dry sediment per cubic yard of wet material (570 kg/cubic yard) are confusing as they differ from that made on pages 16 and 17 for bay sediment

(740 kg/cubic meter), yet the same assumptions are made and citations are used. The numbers are actually the same, however for the general reader, will be confusing as presented.

- 28 Paragraph 2: The assumption that mercury concentrations in sediments disposed of in-bay and out-of-bay are the same may not be valid. Disposal locations are based on sediment chemistry per LTMS documentation (<http://www.spn.usace.army.mil/ltms/issuepaper70899.html>).
- 28 Paragraph 3: Transport of mercury through the Golden Gate assumes on in-bay deposition, uptake by organisms or loss via biomass removal. These assumptions are questioned.
- 29 Paragraph 2. The mercury load lost is 81% of the mercury exiting the bay?? This statement is unclear.
- 29 Paragraph 4. The text indicates that potential loads from mines will be addressed in Section 7 under margins of safety, however on page 55 under the referred to section, there is no attempt to allocate potential loads or provide any margin of safety or discussion thereof. The implementation plan is insufficient; it basically reiterates what is already being done: notification to the owners and continued attempts at collaboration for the current mines out of compliance. No timeline is provided, nor specifics on how to address these sources provided.
- 30 Paragraph 1. Sentence starting “Table 4.7...” is incomplete.
- 30 Paragraph 1. The text indicates that potential loads from bay margin sites will be addressed in Section 7 under margins of safety, however on page 55 under the referred to section, there is no attempt to allocate potential loads or provide any margin of safety or discussion thereof. The implementation plan basically reiterates what is already being done. It seems to be appropriate, however, no timeline is provided.
- 33 Paragraph 2. The fish tissue criterion of 0.2ppm is based on a survey of people who fish in SF Bay and choose to eat their catch. The data used equates to the consumption of approximately 2 lbs of fish per month, or, for a 6 ounce meal, 4 meals of fresh catch per month. This number seem very low, and will result in a proposed target that is set too high. Verification is needed.

- 35 Paragraph 2-3: The bird egg target is proposed to be any value less than 0.5 ppm. This target does not account for the recommendation by the EPA to divide the level of 0.5 by 2 or 3 in order to determine a no-effects level. This document does not consider the EPA recommendation. As written, a bird egg mercury concentration of 0.49 would be acceptable, even when studies indicate that levels “at or above 0.5 ppm could be associated with toxic effects...” (paragraph 2, same page).
- 35 Paragraph 4: The revised bird egg target for the California least tern based on an average mercury concentration for mercury in eggs. How many eggs were collected and analyzed for mercury. Using the average of 0.67 ppm, a reduction of mercury in SF Bay of 25% is needed to drop the egg concentration to 0.50 ppm. NOTE that this is still too high.
- 36 Equation 4: The [suspended sediment] = ....should indicate (dry).
- 36 Paragraph 3-4: A reduction from 0.3 ppm in the sediment to 0.2 ppm in the sediment is a 33% decrease in mercury, not a 50% decrease. The explanation that a 50% drop in each individual RMP sample represents an overall 50% decrease in mercury throughout the Bay is misleading. A 50% drop of 0.01 ppm is not the same as a 50% drop in 0.6 ppm overall. Some segments of the bay will need a greater decrease in mercury concentration than other segments of the bay in order to realize an overall mercury load decrease.
- 37 Paragraph 1 beginning below the bullets: This paragraph is very confusing. The relationship between the 1.0 ppm tissue concentration and 0.025 ug/L mercury concentration needs better clarification.
- 37 Paragraph 2 beginning below the bullets: The statement is made that the least tern is the most sensitive of wildlife. This statement is unclear and only valid if the California least tern is endangered due to mercury bioaccumulation, and not habitat destruction. Also, the statement that if “bird egg concentrations drop below 0.5 ppm, detrimental effects are unlikely to occur” is not verified. Detrimental effects occur at 0.5 ppm and above. The no-effects level is more conservatively estimated by dividing 0.5 by a factor of 2 or 3 (page 35). Such conclusive statements should be avoided.

- 38 Figure 5.2: Inability to show Guadalupe River data on this plot support the need for separate TMDL for the south bay.
- 39 Figure 5.3: The x-axis is unclear. That each of the 391 points plotted represent 15 minute intervals equivalent to 4 days should be explained for the reader.
- 43 Paragraph 3: The expectation that reducing mercury loads will reduce methylmercury production may not apply to all segments of the San Francisco Bay. The discussion of methylmercury production in sediments does not account for the fact that the production of methylmercury is a bacterially mediated process. In more than 50% of the bay, sediment concentrations will be elevated to concentrations above the median concentration of 0.3 ppm, with substantially elevated concentrations in some segments. If mercury as a bacterial substrate is high, a decrease in sediment mercury concentration will not affect the methylmercury production rate.
- 45 Paragraph 4: Many assumptions, generalizations and median/average values are used to estimate the total mass of mercury in the active layer, with the final concentration a non-conservative estimate. This needs to be clearly explained. On page 12, the active sediment layer was estimated to average 15 centimeters (about 6 inches) and is considered be located in the biologically active zone. Sediment, buried up to 1.3 meters beneath this active sediment layer, is that conducive to bed erosion (page 17) and has a mercury concentration of 0.42 ppm (see issues related to this number derivation). NOW, the active layer is described as 0.15 meters deep NOTE that the active sediment layer will vary from south bay to north bay as a function of flushing, mixing and water depth. In addition, mercury concentrations vary as well. .
- 47 Last Paragraph: The parameters of the south bay that may also affect methylmercury production include shallow, anaerobic or low dissolved oxygen, and warmer.
- 48 Table 7.1 A column showing the percent reductions in allocation is of value, as it shows where the effort will go at reducing mercury loads to the bay...with a 98% reduction attributed to the Guadalupe River watershed.
- 49 Paragraph 2: What about the effects of dredging on bed erosion?



- 49 Paragraph 3: The assumption made is that the Central Valley watershed sediment will meet the 0.2 ppm target. What if it does not? What actions will be taken in other loads to account for the inadequate reduction in mercury. Note that the sediment load differs from that used on pages 16 and 19.
- 50 Paragraph 3: The mining legacy associated with the Guadalupe is not well described as with the other allocation sections. It is not clear why the mining legacy associated with other Bay area mines (page 30- Table 4.6) is not addressed as well.
- 50 Paragraph 4: Control of atmospheric deposition by controlling incineration activities using stack control methods could be mentioned.
- 52 Paragraph 1: A problem with the non-urban storm water runoff section is that it includes agricultural lands which were NOT tested and which represent a significant land use, with irrigation return flows.
- 55 Paragraph 2: The statement that available information is insufficient to determine if local mines or bay margin contaminated sites are sources of mercury is not valid as indicated in Table 4.7 (page 30). In addition, documents for these contaminated sites contain considerable data on soil contamination.

Number 1: There are several problems with this analysis. First, data were not for Suisun Bay but for Grizzly Bay, which is north of Suisun Bay (page 17-18). Also, the depth of elevated mercury in Grizzly Bay is 0.9 meters, not 1.3 meters, which is the depth of elevated mercury in San Pablo Bay sediments. Then, the determination of the years for erosion to occur is determined using non-related data: the depth of elevated mercury in San Pablo Bay is divided by the erosion rate of sediment in Suisun Bay to arrive at a time of 110 years. If the Grizzly Bay depth of elevated mercury concentration is used (0.9 meters per Figure 4.2, NOT Figure 4.3), it will only take 75 years to erode. The point being made is that data are being used to determine definitive levels of mercury reduction based on means and medians from various locations, without explanation of margins of safety.

- 56 Paragraph 2: The proposed areas if reduction in load allocation should be identified: Central Valley Watershed, urban storm water runoff, and the Guadalupe River Watershed mining legacy.
- 57 Bullet 3: Limitation of the fish tissue target to large fish is not sufficient. Small fish such as anchovy, herring and others in the SF Bay should be assessed as well. .
- 58 Bullet 3: Additional studies are not implementation measures. Studies do not contribute to the reduction of mercury in the bay. The last sentence states that the bay margin sites have not been confirmed, yet data in Tables 4.6 and 4.7 provide numbers and loads. In addition, identified mercury mines listed have been under review by the RWQCB in some cases for decades. Considerable data are available for some of these sites.
- 59 Paragraph 1-2: The discussion related to seasonal variability and critical conditions is poorly supported. There is no mention of data or reports; there are no plots to show an attempt has been made to determine if there is a trend, yet Figure 5.3 shows diel variability on one day in March of 1997. Certainly, the data show considerable variability in suspended solids over time due to storm runoff events, and given the association between sediment and mercury, a similar trend in mercury concentrations is expected. The report does not adequately address the seasonal component.
- 60 Paragraph 5: The fourth objective of the implementation plan is a surprise. Given that this TMDL is specific to mercury, the implementation plan should focus on mercury. This does not mean that coordination with other water quality programs could not occur or even be encouraged. It does mean that the implementation of a plan to reduce mercury will be evaluated on the merits of doing just that....reducing mercury.
- 62 Box: Several of the required actions are not addressed, such as evaluate mercury bioavailability of discharge and feasibility of minimizing mercury uptake into the food web.
- 62 Paragraph 4: The introduction of credits for load reduction in other source categories is quite controversial. The incorporation into the implementation plan as a mechanism for credit towards attaining allocation is not acceptable. Diversion of urban storm water to a treatment facility means what?? What type of treatment facility? What if the treatment facility does not remove

the mercury? Or, the mercury is transferred to the sludge, and disposed of in a landfill, or used in land applications? Diversion could occur in the Sierra Nevada, and the credit applied resulting in allocations being met for dischargers in the south bay. This means that the anticipated 50% removal of mercury may not occur in areas where it is most needed.

- 66 Paragraph 2: Percentages are used for data that are absolute numbers. This is also done in other sections of the report.
- 66 Paragraph 4 and onto next page: Cremetoria emissions of 12.2 kg/yr is quite high...representing nearly 50 percent of the total existing load (27 kg/yr). The assumption that crematoria emissions will likely decrease based on the decrease in the number of amalgam fillings is flawed. New fillings are for young, somewhat more well-off individuals. The people dying are generally older, and tend to have mercury amalgam fillings. In addition, as the population ages, the number of deaths is expected to increase....so for the next 50+ years, expect an increase in crematoria emissions. This source should be reevaluated.
- 69 Bullets 3 and 4: This effort should be in collaboration with industry.
- 70 Bullet 2: This effort should be in collaboration with municipal wastewater facilities.
- 71 Bullet 1: This effort should be in collaboration with municipal wastewater facilities.
- 71 Bottom of Page: Add No. 3. How much mercury is contained in air emissions?
- 72 Paragraph 3: Add a timeline for taking actions described.
- 73 Paragraph 2 below the numbered actions: Add a timeline for taking actions described.
- 75 Paragraph 2: The proposed requirements to be imposed on those getting dredging permits are non-specific and need to be described.
- 77 Paragraph 2: The trading of pollution credits outside of the watershed is identified as a possible approach. It is unclear how this will help to reduce the mercury load in the SF Bay watershed. Insufficient information is provided. Development of an approach is left to the various entities being regulated, instead of by the regulator.

- 78 Evaluation of Fish Tissue Target: Use of a linear relationship as described is only valid if data are analyzed across the entire length range. As proposed, the validity of using data for fish 60 cm in length as a measure of meeting the fish target will still only apply to fish in the 45 to 82 cm size range. .
- 82 Bullet 1: The active sediment layer is only estimated on average to be about 15 centimeters. However, substantially thicker areas can exist, where stratification occurs. Nephroid layers are common in most large bodies of water, and are quite variable with depth.
- 84 Paragraph 1: The use of fish species other than striped bass is recommended. A native fish that lives its life within the SF Bay should be assessed.
- 103 Typo in citation for Krone, 1979..
- A-2 Second set of bullets: The application of the TMDL to Castro Cove, Oakland Inner Harbor and San Leandro Bay has not been discussed prior to this point. These sections of the bay are quite different in that they are working harbors, with much different sedimentation processes. The discussion of how these areas will be addressed in not provided.
- A-3 Top of page: Application of the linear model to fish outside the model range is not acceptable.